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RESULTS
OF
EXPERIMENTAL TRIALS

OF THE

AMERICAN ANTI-INCRUSTATOR,

BY

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417 WALNUT STREET, PHILADELPHIA.

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(1867)

OFFICE OF THE AMERICAN ANTI-INCRUSTATION COMPANY,
No. 147 South Fourth St., cor. of Harmony,

Philadelphia, April 5th, 1867.

CHARLES M. CRESSON, M. D.,

DEAR SIR:—The Commission referred to in the appended advertisement, have commenced their examination of the various inventions for preventing explosions in steam boilers, and it is the wish of the American Anti-Incrustation Company to place before them the proofs of the efficacy of their instruments for the removal and prevention of scale in steam boilers. As you have for some time been engaged in an investigation of the matter, you will oblige us by preparing such a condensed statement of your results as you think will best elucidate the subject. We propose to submit such a statement to the Commission, and think it advisable that you shall appear before them to give such farther explanations as they may desire.

Your Obedient,

JAMES HARPER,
Managing Director for Company.

TO INVENTORS AND OTHERS.

Notice is hereby given, that the members of a Commission, acting under the authority of the Secretary of the Treasury, will meet in the city of New York, at the office of the Supervising Inspector of Steamboats, No. 23 Pine Street, on the second Monday in April, proximo, for the purpose of examining and testing the merits of such inventions of a life-saving character as may be brought before them.

Said inventions will embrace boilers of steam engines, anti-incrustators, safety valves, steam gauges, water gauges, steering apparatus, life-boats, with detaching apparatus, &c., &c.

Inventors may appear in person before the Commission, for the purpose of explaining their inventions; but no expenses will be allowed under any circumstances.

H. McCULLOCH, *Secretary of the Treasury.*

WASHINGTON, D. C., March 13th, 1867.

OFFICE AND LABORATORY,
Schuylkill Navigation Building, 417 Walnut St.,
Philadelphia, April 15th, 1867.

JAMES HARPER, Esq.,
Managing Director American Anti-Incrustation Co.

DEAR SIR:—In answer to yours of the 9th inst., I have prepared this condensed statement of the most prominent results of my examination of your instruments for the removal and prevention of scale in steam boilers, with the deductions which seem to follow from the experiments.

In order to make the explanations of the principles involved more intelligible, I have prepared a few simple diagrams, exhibiting to the eye the direction of the obscure currents produced by the conjunction of electrical and magnetic forces.

The apparatus furnished by the American Anti-Incrustation Company consists, in its simplest form, of a magnetic bar of hardened steel, suspended horizontally within the steam boiler, in the upper part of the steam space, the south pole of the bar connected with the shell of the boiler, and the north pole supported by an insulated hook.

If the magnetic bar be not of sufficient length to extend nearly throughout the horizontal steam space,

it may be prolonged by a rod or wire of metal, so as to connect the south pole with the boiler; care being taken to keep this wire insulated from immersion in the water, and from metallic contact with the boiler, except at its point of attachment to the shell.

In large boilers it is usual to place three or more bar-magnets side by side with their south poles, secured to a block of metal, which block is connected with the shell of the boiler; and in very long boilers several instruments may be set at varying distances from the end of the boiler, all presenting the south pole to that end with which they are connected.

Experimental trials made upon the apparatus, and modifications of it, have elicited certain facts.

If we replace the magnet-bar by a bar of steel, without polarity, and employ a solution in the boiler which will deposit scale upon the application of heat, we find that the neutral bar gradually obtains polarity, and that the insulated end becomes a south pole; the deposit of scale then taking place with great rapidity.

With the magnet-bar properly placed, with its north pole insulated and its south pole connected with the boiler, the scale already formed is gradually removed, and any fresh deposit prevented.

During the performance of this work, the bar slowly loses its polarity, and if, at this time, it be not remagnetized, it will eventually assume the reverse polarity, and fail to prevent the formation of scale.

If, in placing the instrument within the boiler, we so arrange it that the outflowing steam shall pass along the bar in a direction from its south pole towards its north pole, then is its action increased; but if the outflowing steam pass it in a contrary direction, we may not only retard, but entirely prevent, the proper working of the instrument.

In order to determine the effect of the polarized bar upon the electrical currents in the water, insulated wires were passed through the outer shell of the boiler, and the exposed ends of the wires fixed at varying distances from the bottom surface inside: these wires were successively connected with one pole of a galvanometer, whilst to the other pole was connected a wire in metallic contact with the shell on the outside.

During the formation of scale, the electrical current was mostly passing from the water to the shell. Upon inserting the polarized bar in a proper position, the direction of this current was reversed and passed from the shell to the water.

In addition to the influence of the nearly constant passage of steam from the boiler, by the ordinary outlet, various temporary minor modifications of the thermo-electric currents are caused by the use of the blow-out and gauge cocks, and by any check to the fires beneath the boilers—such as by the addition of fresh fuel. The general direction of the current is toward an outlet of the boiler; more especially such an one as may be conveying off water or wet steam.

The tendency of electrical and thermal currents to proceed in the same direction, renders it a matter of some importance to locate properly the general steam outlet and blow-outs, in reference to the furnace, so that the currents induced may not interfere with each other.

To assist in explaining the relations which heat, electricity and magnetism bear to each other, and the modes of their conversion, I have selected the following principles, as announced by Faraday, Grove, Noad and others, in their researches, together with the illustrations of their action:—

“To obtain electricity from magnetism, it is necessary to superadd motion.”

“Magnetism will produce electricity with the help of a dynamic force (heat).”

“Bodies affected by an electrical current, are definitely moved by a magnet in proximity to them; and so, conversely, bodies moved near a magnet, have an electrical current developed in them.”

Faraday's illustration of these abstract principles is as follows:—

A copper plate, mounted on an axis, is furnished, with a handle for giving it motion; one wire, connected with a galvanometer, is retained in perfect metallic contact with the axis, and another, connected also to the galvanometer, is kept in contact with the circumference of the disc. A horse-shoe magnet is so placed as to embrace, with its poles, the disc and wire in contact with the circumference,

but without touching them; the north pole of the magnet being towards the observer, and upon the left hand side of the disc.

When the machine is made to revolve from right to left, a current of electricity flows from the centre to the circumference of the disc. If the revolution of the disc, or poles of the magnet, be reversed, the direction of the electrical current is reversed also, and proceeds from the circumference to the centre of the disc. A similar effect can be produced by drawing a slip of metal between the poles of the magnet.

“So, also, when a plate of metal is made to rotate beneath a magnetic pole, (suppose a north pole) a series of currents of electricity will pass from the centre to the circumference of the plate, if it is rotating in the direction of the hands of a watch; or, from the circumference to the centre, if it is rotating in the contrary direction.”

This directive power, which the magnet possesses over electrical and thermal currents, explains why the magnetic force of the instrument, employed for removing incrustation from steam boilers, should be diminished, and finally reversed, when the outflowing steam is compelled to pass it in a direction from its north pole to its south pole, and why the effect of the magnets is increased by the passage of steam in the contrary direction, or from its south pole to its north pole, as well as the occasion of the magnetic condition of the boilers of opposite polarity to that

of the directing magnet, as the currents inducing it proceed from its upper surface.

“An electric current appears to have a magnetic action in a direction cutting it at right angles.”

“Thermo-electricity connects heat with electricity, and consequently with magnetism.”

To give an idea of the magnetic force, and its magnitude and direction, as developed by the action of apparently weak thermal currents, attention need only be directed to the earth itself. The earth is considered to be a great magnet, produced by electrical currents circulating around it.

Dr. Prout thus explains the causes of these electrical currents:—

The earth, during its diurnal motion on its axis from west to east, has its surface successively exposed to the solar rays in an opposite direction, or from east to west. The surface of the earth, therefore, particularly between the tropics and in parallel zones, will be heated and cooled in succession from east to west, and currents of electricity, on thermo-electric principles, will, at the same time, be established in the same direction. Now these currents thus established, from east to west, give rise to the magnetism of the earth from north to south; hence the magnetic directive power of the earth, in a direction nearly parallel with its axis, is derivable from the thermo-electric currents, induced principally by its diurnal motion.

“When substances are undergoing chemical changes, and a magnet is brought near to them, the direction or lines of action of the chemical force will be changed. In these cases there is not a *production* of light, heat or chemical affinity by magnetism, but a *change* in their *direction* or mode of action.”

In illustration of this principle, Prof. Grove gives Dr. Maggi's experiment, exhibiting a change in the direction of thermal conduction under the influence of magnetic polarity:—

Cover a plate of homogeneous soft iron with a thin coating of wax, mixed with oil—a tube traversing the centre, through which the vapor of boiling water is passed, the plate to rest on the poles of an electro-magnet, with card interposed. When the iron is not magnetized, the melted wax assumes a circular form, the tube occupying the centre; but when the electro-magnet is put in action, the curve marking the boundary of the melted substance changes its form and becomes elongated in a direction transverse to the line joining the poles, showing that the conducting power of the iron for heat is changed by the magnetism.

From an examination of the principles above expressed and illustrated, in combination with other well-known laws, the following conclusions are reached:—

First.—In a steam boiler, the thermal, and consequently the electrical currents, flow alternately towards and from the heated shell, as induced by

variations of the temperature of the different parts of the shell and water, until some great disturbance of electrical tension is made by taking off steam or water rapidly; when, in order to restore the equilibrium of tension, electrical currents near to the shell of the boiler flow constantly to it—as the metal is a better conductor of electricity than water—carrying with them any matter that may be in solution or in suspension, and thus cause formation of scale in compact columnar form.

Second.—The thermo-electrical currents can be controlled by a suitable magnetic force; and therefore the magnets used in the American Anti-Incrustation Company direct the lines of thermo-electric action, and in this way remove or enfeeble the causes of the compact deposition of bodies in solution or suspension in the water in the boiler.

Third.—Where scale has already been formed previous to the application of the instrument, it is repelled by the agency of magnetic and dia-magnetic forces, exerted in consequence of the polarity of the shell of the boiler, induced by the movement of the thermo-electric currents, directed or governed by the magnetic bar of the instrument; which repulsion favors the intrusion of a minute film of water between the iron of the boiler and the scale, and the latter is loosened and broken up by the expansion of the watery film into steam.

A further proof of the correctness of these assumptions, is found in the fact that by exalting the inten-

sity of magnetic action, by the substitution of a powerful electro-magnet in place of the weaker permanent magnets commonly used, the effects of deposition and removal of scale, as already described, take place with such increased rapidity as to produce, in a few hours, results which, with the ordinary apparatus, have required many weeks or months.

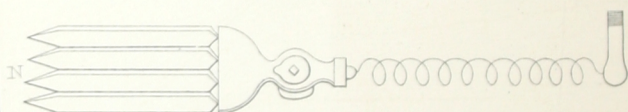
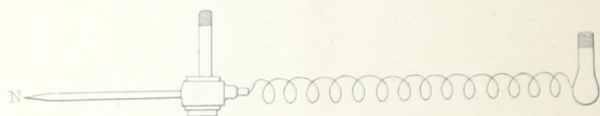
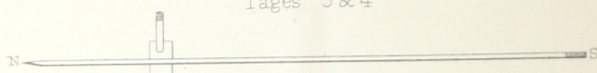
The introduction of metals in the water of the boiler, which are electro-negative or electro-positive to the metal in the shell, (copper or zinc) either tend to corrode the boiler, or to oppose the action of the instruments.

In the whole course of these experiments there has been no evidence of the production of any galvanic action having the slightest tendency to oxydize, or in any way to injure the metal of the boiler.

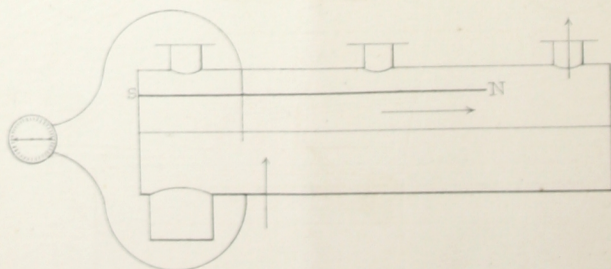
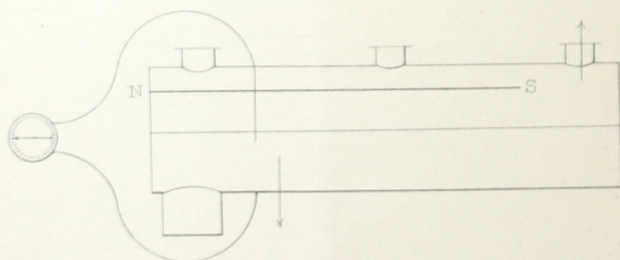
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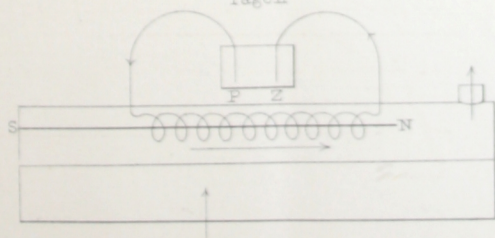
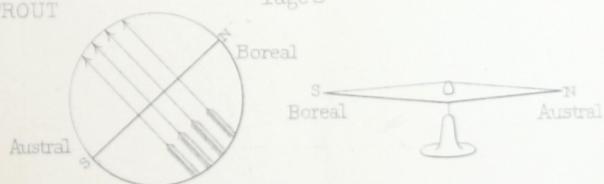
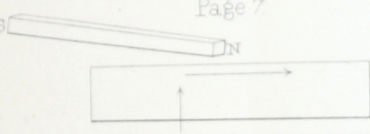
CHARLES M. CRESSON.

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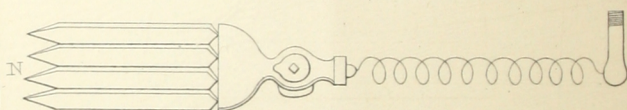
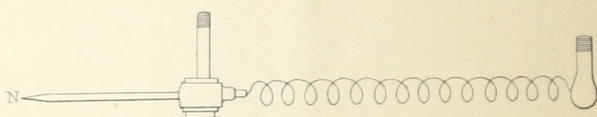
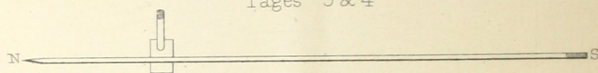


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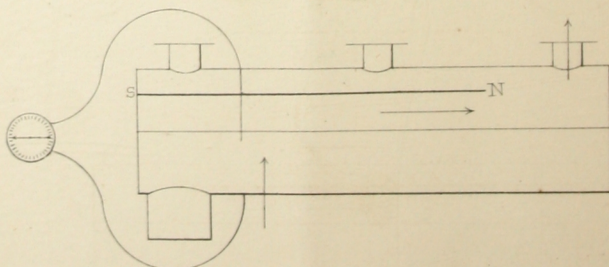
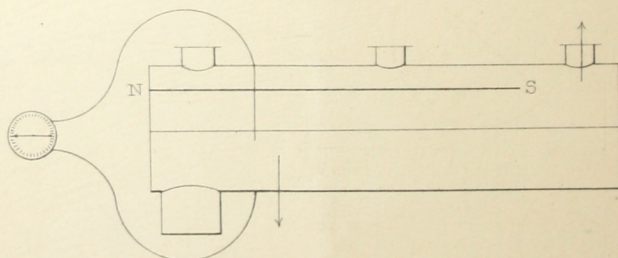




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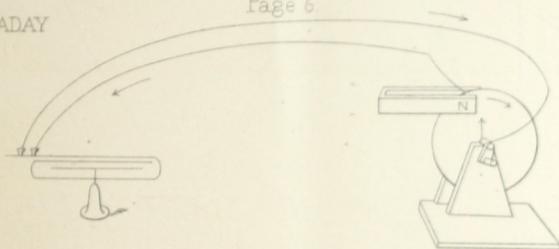


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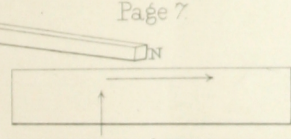
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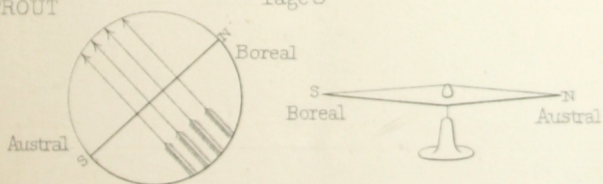
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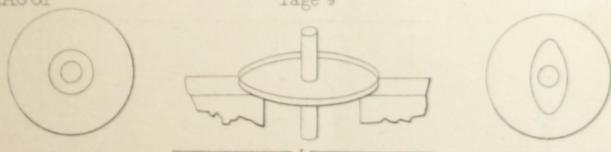
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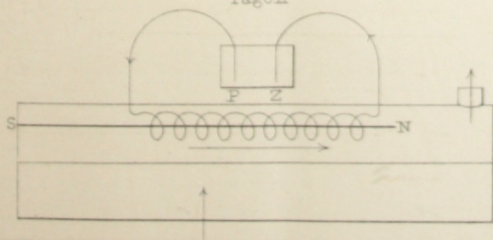


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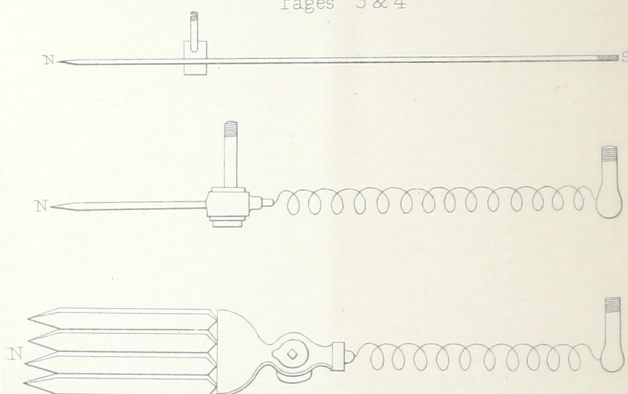
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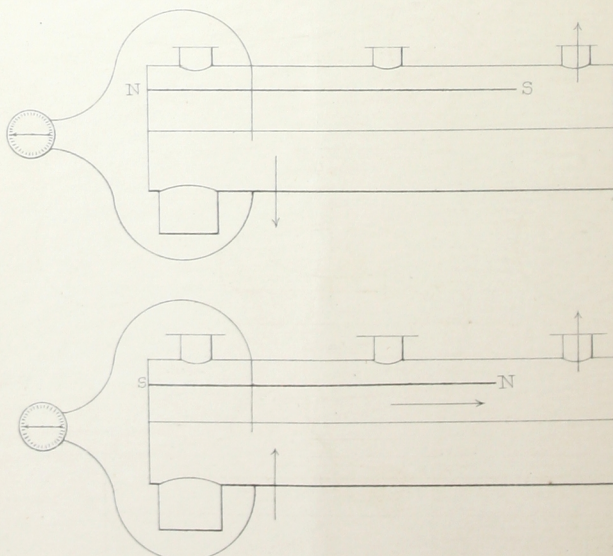
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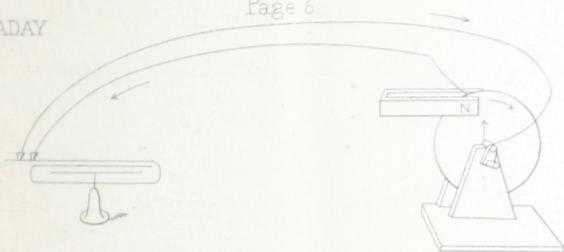


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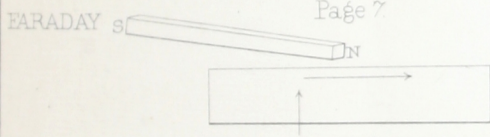


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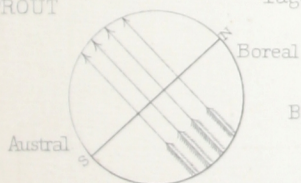


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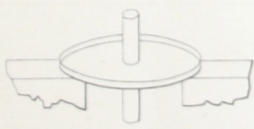
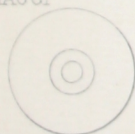
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